Yields of CORN HYBRIDS HARVESTED FOR SILAGE

Second Report

By W. B. Nevens
and G. H. Dungan

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CONTENTS

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By W. B. Nevens and G. H. Dungan[1]

NEARLY ALL the Illinois corn acreage in recent years has been planted to hybrids. While most of the crop is harvested for grain, a substantial acreage is cut for silage. In 1945, 202,000 acres were harvested for silage, this acreage producing 1,737,000 tons of forage.[2] Only six states cut a greater acreage than Illinois. Four of those states had more milk cows than Illinois and the other two had almost as many.

The production of each new hybrid raises questions about its merits for silage as well as for grain. The value of a hybrid for silage depends not only on its yield of forage but also on the proportion of the forage the ears form, the ability of the plants to stand erect, and the general adaptability of the hybrid to the region or locality.

A study of the value of corn hybrids for silage was begun at this Station in 1935; a summary of the work for seven seasons was published in 1942 as Bulletin 494, "Yields of Corn Hybrids Harvested for Silage." The development of numerous new hybrids and the demand for further information prompted a continuation of the investigation. This bulletin summarizes the experimental findings for the five seasons 1942 thru 1946.

PLAN OF INVESTIGATION

The corn tested in the experiments here reported was grown the first season (1942) on a farm near Urbana rented and operated by the Department of Dairy Husbandry and during the next four seasons

[1] By W. B. Nevens, Professor of Dairy Cattle Feeding Research, and G. H. Dungan, Professor of Crop Production Research. The authors gratefully acknowledge the advice of C. M. Woodworth, Professor of Plant Genetics Research, concerning certain details of this study, the services of R. S. Smith, Professor of Soil Physics Research, and H. L. Wascher, Assistant Professor of Soil Survey Research, in classifying the soils of the fields on which the corn was grown, and the help rendered by K. E. Harshbarger, Assistant Professor of Dairy Production Research, in the collection of data.

[2] *Crops and Markets*, U.S.D.A., January and May, 1946.

Table 1. — Pedigrees of Illinois and U. S. Hybrids Tested for Yields of Forage for Silage

Hybrid	Pedigree	Hybrid	Pedigree
Ill. 21	(WF9 × 38-11) (187-2 × Hy)	Ill. 801	(5120 × Kys) (K4 × L317)
Ill. 126	(WF9 × 38-11) (Tr × L317)	Ill. 804	(5120 × 38-11) (K4 × L317)
Ill. 200	(WF9 × 38-11) (K4 × L317)	Ill. 838	(38-11 × Pr) (K4 × L317)
Ill. 201	(WF9 × 38-11) (187-2 × L317)	Ill. 855	(R4 × Hy) (G × L317)
Ill. 206	(WF9 × 38-11) (5120 × L317)	Ill. 863	(R4 × Hy) (K4 × L317)
Ill. 246	(WF9 × Hy) (187-2 × L317)	Ill. 877	(R4 × Pr) (K4 × L317)
Ill. 246A-1	(WF9 × 187-2) (Hy × R57)	Ill. 972	(WF9 × Hy) (701 × L317)
Ill. 247	(187-2 × 38-11) (Hy × L317)	Ill. 972A-1	(WF9 × O7) (Hy × L317)
Ill. 247-1	(187-2 × 38-11) (Hy × R57)	Ill. 972-2	(WF9 × Hy) (O7 × R57)
Ill. 273	(WF9 × 38-11) (187-2 × 701)	Ill. 2059(W)	(Ky27 × CI.61) (33-16 × K6)
Ill. 448	(38-11 × Kys) (K4 × L317)	Ill. 2077(W)	(33-16 × CI.61) (Ky27 × CI.43)
Ill. 713	(WF9 × 38-11) (G × L317)	Ill. 2119(W)	(Ky27 × CI.61) (33-16 × K64)
Ill. 784	(Hy × 5120) (K4 × L317)	U.S. 13	(Hy × L317) (WF9 × 38-11)

(1943-1946) on Station land at Urbana.[1] Hybrids which have excellent grain production records were chosen for these tests.

It was shown in the first of these studies (1935-1941, reported in Bulletin 494) that hybrid corn was superior to open-pollinated in production of forage. Therefore the use of an open-pollinated variety as a standard, or check, was discontinued and a well-known and widely grown hybrid, U. S. 13, was used in its place. Studies were made of 25 Illinois hybrids. The pedigrees of these hybrids are given in Table 1.

"Block" Plan of Planting Used

The land on which the corn was grown was prepared for planting by either fall or spring plowing, followed by disking, harrowing, and if necessary rolling to give a good seedbed. The seed was drilled in rows 3.5 feet apart. The corn was cultivated first with a rotary hoe and later with a shovel cultivator.

A "block" plan of planting was followed in order to make it easier

[1] The field used in the 1942 tests contains a combination of Flanagan and Thorp Silt Loams and Drummer Clay Loam. The field is level. Drainage on the Thorp Silt Loam is slow because of the character of the subsoil.

One of the two fields used in 1943, 1944, and 1945 is underlain by outwash sands. Two soils occur in this outwash area, Brenton Silt Loam and Drummer Clay Loam. Catlin Silt Loam occurs on the highest parts of the field and Flanagan Silt Loam on the lower parts of the slopes bordering the outwash.

The other field used in 1943, 1944, and 1945 consists mainly of Flanagan Silt Loam, while the field used in the 1946 tests is composed of Drummer Clay Loam.

The agricultural ratings of these soils are: Thorp 4-5; Flanagan 2; Brenton 2; and Drummer 1. The number indicates the ability of the soil type to produce the major crops grown in the region without soil treatment but with the soil cleared and drained. The scale is 1 to 10, the most productive soil in the state being rated 1 and the least productive 10.

to use a machine which harvests and chops the forage in one operation. The blocks ranged from about 77 to 97 rods long; a single block comprised about 10 acres. Each block was surrounded by a 20-foot border of late-planted soybeans harvested prior to corn harvest or by a 20-foot border kept fallow.

Twelve hybrids were grown each season. They were given entry numbers of 1 to 12 to facilitate plot numbering and record keeping. In Block 1 four rows (one round with a two-row planter) of Entry 1 were planted at one side of the field. Four rows of Entry 2 were planted next to Entry 1. Entry 2 was then followed by four rows of each of the other entries until each of the twelve entries had been planted. Then four rows of Entry 11 were planted followed by four rows each of Entries 10, 9, 8, etc. This planting system provided four rows of Entry 1 at each side of the field, making it practicable to harvest the forage with a machine which was best operated by circling the entire block. A further advantage of the planting system was that each hybrid except the one in the middle of the block grew in two separate parts of the field.

Five complete blocks, or replications, were grown each season except in 1942, when there were six replications. When the planting of Block 1 was completed, a randomized system of planting the remaining blocks was followed. This system provided for a rearrangement of the order of planting the entries, a different order being used in each block. In this manner the effects of being on the border and the possible influences of one entry on an adjoining one were minimized. The planting plan provided a suitable basis for a statistical analysis of the yield data.

Measuring Forage Yields

Field sampling. One method of measuring forage yields for silage was field sampling: the yields were calculated from the weight and dry-matter content of representative samples of the standing corn.

Field samples were usually taken just before the corn was harvested for silo filling. Samples of each entry were taken from rows planted by each of the boxes of the planter. The samples consisted of every hundredth plant from two rows, each row about 77 or 97 rods long.

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Ill. 713	(WF9 × 38-11) (G × L317)	Ill. 2119(W)	(Ky27 × C1.61) (33-16 × K64)
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Table 2. — Dry-Matter Yields of Corn Harvested for Silage, Test Weights of Dry Grain, Proportion of Erect Plants, 1942-1944, 1946; and Number of Ears per Plant, 1945

(Figures showing dry matter are in tons per acre)

Entry	Dry matter in field samples[a]				Dry matter in harvested forage[b]	Test weight of grain per bushel[a]	Weight of 500 kernels[a]	Erect plants[a]
	Ears[a]	Stalks	Leaves	Total				
1942: A difference between any two entries of less than .397 ton of dry matter in harvested forage is not significant.								
	tons	*tons*	*tons*	*tons*	*tons*	*lb.*	*grams*	*perct.*
Illinois 200	.93	.78	.63	2.34	**3.24**	53.9	93	97.6
Illinois 801	.57	.99	.76	2.32	**3.21**	51.3	77	96.9
Illinois 206	1.11	.82	.65	2.58	**3.20**	54.0	97	97.7
Illinois 448	.67	1.06	.79	2.52	**3.12**	53.7	85	97.1
Illinois 784	.87	1.04	.76	2.67	**2.96**	53.0	85	96.1
Illinois 201	.91	.64	.58	2.13	**2.95**	53.3	93	96.7
Illinois 838	.93	1.00	.73	2.66	**2.92**	54.8	89	94.9
Illinois 21	1.07	.87	.62	2.55	**2.92**	54.6	98	97.4
U. S. 13	1.04	.72	.57	2.33	**2.83**	55.8	105	95.6
Illinois 804	.97	.87	.71	2.55	**2.81**	55.2	94	94.5
Illinois 247	1.09	.90	.64	2.63	**2.80**	55.0	99	97.8
Illinois 126	.98	.83	.57	2.38	**2.59**	52.9	91	95.9
All entries, average	.93	.88	.67	2.47	**2.96**	54.0	92	96.5
1943: A difference between any two entries of less than .447 ton of dry matter in harvested forage is not significant.								
Illinois 713	2.53	1.18	1.11	4.82	**4.48**	53.3	108	99.0
Illinois 863	2.61	1.26	1.13	5.00	**4.34**	55.0	95	93.9
Illinois 206	2.79	1.32	1.04	5.15	**4.33**	57.1	126	98.3
Illinois 200	2.64	1.26	1.13	5.03	**4.30**	56.1	110	98.5
Illinois 784	2.27	1.22	1.04	4.53	**4.28**	55.5	102	98.0
U. S. 13	2.64	1.24	1.01	4.89	**4.22**	55.6	117	99.1
Illinois 838	2.36	1.33	1.17	4.86	**4.21**	54.9	101	98.1
Illinois 246	2.55	1.18	.90	4.63	**4.14**	56.2	120	98.9
Illinois 247	2.51	1.13	.98	4.62	**4.06**	55.3	105	98.5
Illinois 201	2.63	1.22	1.04	4.89	**4.01**	55.3	111	98.9
Illinois 448	2.29	1.36	1.22	4.87	**3.97**	53.9	82	97.4
Illinois 21	2.54	1.27	1.11	4.92	**3.92**	54.7	110	99.3
All entries, average	2.53	1.25	1.07	4.85	**4.19**	55.2	107	98.2
1944: A difference between any two entries of less than .273 ton of dry matter in harvested forage is not significant.								
Illinois 784	1.59	1.41	1.12	4.12	**4.66**	....	...	80.4
Illinois 804	1.67	1.42	1.10	4.19	**4.59**	....	...	85.5
Illinois 863	1.71	1.46	.98	4.15	**4.56**	....	...	77.8
Illinois 206	1.82	1.34	1.01	4.17	**4.48**	....	...	86.7
Illinois 448	1.26	1.56	1.11	3.93	**4.46**	....	...	87.0
U. S. 13	1.76	1.20	1.00	3.96	**4.43**	....	...	89.8
Illinois 713	1.61	1.26	1.21	4.08	**4.29**	....	...	91.5
Illinois 201	1.88	1.27	1.01	4.16	**4.28**	....	...	89.4
Illinois 972	2.00	1.36	1.22	4.58	**4.24**	....	...	75.3
Illinois 273	1.77	1.19	.98	3.94	**4.20**	....	...	93.3
Illinois 2077(W)	1.37	1.48	1.07	3.92	**4.20**	....	...	82.4
Illinois 855	1.34	1.41	1.13	3.88	**4.08**	....	...	89.6
All entries, average	1.64	1.36	1.08	4.09	**4.37**	....	...	85.7

(Table is concluded on next page.)

Table 2. — Dry-Matter Yields of Corn Harvested for Silage — concluded

(Figures showing dry matter are in tons per acre)

Entry	Dry matter in field samples[a]				Dry matter in harvested forage[b]	Test weight of grain per bushel[a]	Weight of 500 kernels[a]	Ears per plant[a]
	Ears[a]	Stalks	Leaves	Total				
1945: A difference between any two entries of less than .386 ton of dry matter in harvested forage is not significant.								
	tons	*tons*	*tons*	*tons*	*tons*	*lb.*	*grams*	
Illinois 2119(W)	1.31	1.65	1.08	4.04	**4.65**	38.7	63	1.27
Illinois 448	1.29	1.71	1.22	4.22	**4.57**	40.1	57	1.21
Illinois 206	1.61	1.31	.93	3.85	**4.57**	44.9	71	1.34
Illinois 200	1.59	1.47	1.06	4.12	**4.56**	43.5	76	1.26
Illinois 877	1.60	1.51	1.35	4.46	**4.48**	44.5	65	1.45
Illinois 784	1.34	1.55	1.08	3.97	**4.48**	41.4	59	1.14
U. S. 13	1.62	1.49	1.03	4.14	**4.42**	45.3	82	1.08
Illinois 2059(W)	1.37	1.50	.98	3.85	**4.42**	37.8	69	1.25
Illinois 2077(W)	1.48	1.79	1.16	4.43	**4.28**	37.2	64	1.09
Illinois 126	1.64	1.24	.96	3.84	**4.28**	47.2	78	1.13
Illinois 804	1.61	1.64	1.00	4.25	**4.23**	46.8	71	1.33
Illinois 972-2	1.52	1.32	.97	3.81	**4.07**	45.5	78	1.15
All entries, average	1.50	1.52	1.07	4.08	**4.58**	42.7	69	1.23
1946: A difference between any two entries of less than .412 ton of dry matter in harvested forage is not significant.								
								(Erect plants[a])
								perct.
Illinois 877	2.12	1.44	1.11	4.67	**4.72**[c]	54.0	109	70.7
U. S. 13	2.32	1.45	1.18	4.94	**4.55**[d]	53.5	114	78.8
Illinois 972A-1	2.20	1.40	1.10	4.60	**4.48**[d]	54.7	112	72.3
Illinois 247-1	1.82	1.53	1.02	4.41	**4.38**[c]	52.3	109	74.1
Illinois 126	2.06	1.59	1.29	4.94	**4.37**[d]	50.2	88	70.6
Illinois 246A-1	1.80	1.64	1.01	4.45	**4.35**[c]	45.3	95	49.1
Illinois 21	1.70	1.72	1.19	4.61	**4.28**[d]	50.0	115	52.7
Illinois 2077(W)	2.16	1.43	1.01	4.60	**4.28**[d]	54.3	103	72.4
Illinois 448	2.07	1.34	.92	4.33	**4.26**[c]	52.8	112	69.5
Illinois 2119(W)	1.66	2.01	1.46	5.13	**4.21**[d]	48.8	78	50.4
Illinois 784	1.71	1.60	1.26	4.57	**4.14**[c]	47.0	101	44.8
Illinois 2059(W)	2.09	1.68	1.20	4.97	**4.07**[d]	52.7	99	68.0
All entries, average	1.98	1.57	1.15	4.69	**4.34**	51.3	103	64.5

[a] Means of three replications. (In 1942 only the grain was included in the analysis of the dry matter in the field samples.) [b] Forage yields in 1942 are the means of six replications; those in 1943, 1944, and 1945 are the means of five replications. [c] Means of five replications in 1946. [d] Means of four replications in 1946.

Yields of forage and ears not directly related. At the silage-harvesting stage there is no direct relation between the yield of dry matter in harvested forage and the proportion of dry matter formed by the ears. For example, Illinois 246A-1 was slightly above the average, while Illinois 21, 784, and 2119(W) were nearly equal to it in yield of forage (Table 2, 1946), but the proportion of ears in their forage was lower than that of the other entries (Table 3, 1946). It is thus evident that some late-maturing hybrids produce satisfactory yields of forage. Their feeding value per ton, however, is likely to be less than that of forage containing a high proportion of ears. Moreover, in

Table 3. — Dry-Matter Content of Ear, Stalk, and Leaf at Time Crop Was Harvested for Silage, and Proportion Each Part of the Plant Contributed to Total Crop

(Expressed in percentage)

Entry	Dry matter in sample				Proportion of dry matter of crop in—		
	Ear[a]	Stalk	Leaf	Crop	Ears	Stalks	Leaves
1942							
U. S. 13	33.0	20.7	25.9	26.3	44.6	30.9	24.5
Illinois 206	32.9	20.5	24.5	25.8	43.0	31.8	25.2
Illinois 201	33.1	21.5	27.4	27.2	42.7	30.0	27.2
Illinois 21	32.6	22.7	24.9	26.7	41.8	34.0	24.2
Illinois 247	33.5	21.3	26.2	26.5	41.5	34.2	24.3
Illinois 126	31.0	22.4	26.8	26.8	41.2	34.9	23.9
Illinois 200	31.1	21.5	25.8	25.8	39.8	33.3	26.9
Illinois 804	32.9	20.5	26.1	25.7	38.0	34.1	27.9
Illinois 838	32.1	23.2	27.1	27.0	35.0	37.6	27.4
Illinois 784	30.9	22.6	28.7	26.6	32.6	39.0	28.4
Illinois 448	23.7	22.8	25.2	23.9	26.6	42.1	31.3
Illinois 801	22.4	22.2	25.3	23.2	24.6	42.7	32.7
All entries, average	30.8	21.8	26.2	26.0	37.6	35.4	27.0
1943							
Illinois 246	47.4	20.5	28.2	31.7	55.1	25.5	19.4
Illinois 247	44.3	19.8	27.3	30.4	54.3	24.5	21.2
Illinois 206	47.4	19.8	28.7	31.3	54.2	25.6	20.2
U. S. 13	44.6	20.0	29.9	31.1	54.0	25.4	20.7
Illinois 201	45.4	20.3	27.7	31.0	53.8	25.0	21.3
Illinois 200	44.2	19.7	28.2	30.2	52.5	25.1	22.5
Illinois 713	43.2	19.2	26.0	29.2	52.5	24.5	23.0
Illinois 863	46.2	19.1	27.6	30.1	52.2	25.2	22.6
Illinois 21	45.0	20.2	28.1	30.5	51.6	25.8	22.6
Illinois 784	47.8	19.7	27.7	30.7	50.1	26.9	23.0
Illinois 838	42.4	19.7	26.1	28.5	48.6	27.4	24.1
Illinois 448	40.0	20.0	27.4	28.3	47.0	27.9	25.0
All entries, average	44.8	19.8	27.7	30.3	52.2	25.7	22.1
1944							
Illinois 201	35.9	18.9	25.7	26.2	45.2	30.5	24.3
Illinois 273	37.1	17.5	24.5	25.3	44.9	30.2	24.9
U. S. 13	37.8	18.1	27.8	26.7	44.4	30.3	25.3
Illinois 972	38.6	19.6	23.1	26.3	43.7	29.7	26.6
Illinois 206	37.6	19.2	26.5	26.7	43.7	32.1	24.2
Illinois 863	33.5	17.1	22.3	22.9	41.2	35.2	23.6
Illinois 804	34.4	18.0	23.7	24.1	39.9	33.9	26.2
Illinois 713	33.1	18.0	24.1	24.2	39.4	30.9	29.7
Illinois 784	36.9	18.9	27.4	26.0	38.6	34.2	27.2
Illinois 2077(W)	32.8	19.2	22.5	23.5	34.9	37.8	27.3
Illinois 855	32.4	20.7	22.2	24.0	34.5	36.4	29.1
Illinois 448	29.7	18.4	23.4	22.5	32.1	39.7	28.2
All entries, average	35.0	18.6	24.4	24.9	40.2	33.4	26.4

[a] In 1942 only the grain was included.

(Table is concluded on next page.)

Table 3. — Dry-Matter Content of Ear, Leaf, and Stalk — concluded
(Expressed in percentage)

Entry	Dry matter in sample				Proportion of dry matter of crop in—		
	Ear	Stalk	Leaf	Crop	Ears	Stalks	Leaves
1945							
Illinois 126	42.1	19.4	25.0	27.1	42.7	32.3	25.0
Illinois 206	38.2	19.1	25.1	26.0	41.8	34.0	24.2
Illinois 972-2	40.7	20.7	26.7	27.7	39.9	34.6	25.5
U. S. 13	39.8	20.2	26.7	27.0	39.1	36.0	24.9
Illinois 200	36.1	19.5	24.0	25.2	38.6	35.7	25.7
Illinois 804	38.1	20.9	24.9	26.4	37.9	38.6	23.5
Illinois 877	34.2	18.7	26.2	24.9	35.9	33.9	30.2
Illinois 2059(W)	30.3	19.7	24.9	23.9	35.6	39.0	25.4
Illinois 784	34.2	18.9	25.2	24.1	33.8	39.0	27.2
Illinois 2077(W)	35.8	20.5	23.5	24.9	33.4	40.4	26.2
Illinois 2119(W)	35.0	21.3	25.5	25.7	32.4	40.9	26.7
Illinois 448	30.2	19.9	23.8	23.4	30.6	40.5	28.9
All entries, average	36.2	19.9	25.1	25.5	36.8	37.1	26.1
1946							
Illinois 448	40.7	20.1	23.8	27.7	47.8	30.7	21.5
U. S. 13	40.6	19.4	25.8	27.8	47.0	29.3	23.7
Illinois 2077(W)	41.8	19.7	25.6	28.1	46.8	31.0	22.2
Illinois 972A-1	39.6	18.5	24.3	26.0	46.7	30.0	23.3
Illinois 247-1	35.1	20.3	25.3	26.1	46.5	31.8	21.7
Illinois 877	40.1	21.6	25.1	28.4	42.1	36.1	21.8
Illinois 2059(W)	41.6	20.5	26.2	27.9	41.6	34.4	24.0
Illinois 126	38.5	19.5	25.4	26.6	41.4	32.3	26.3
Illinois 246A-1	39.3	21.7	23.4	27.1	38.1	38.2	23.7
Illinois 21	38.2	20.9	22.7	25.7	37.0	37.2	25.8
Illinois 784	37.2	20.6	23.9	25.9	33.6	36.7	29.7
Illinois 2119(W)	32.4	21.1	25.7	25.2	31.9	39.5	28.6
All entries, average	38.8	20.2	24.8	26.9	41.7	33.9	24.3

seasons of early frost the crop left after silos have been filled may not produce mature grain. (For further discussion of the desirability of hybrids that yield large amounts of grain, see pages 378-379.)

Yield of ears. The yields of ears of the various entries indicate that all of the hybrids entered in the 1946 test are potentially high producers of grain (Table 2). Lateness of maturity and inability to develop a full crop of ears at the silage stage is undoubtedly the reason for the relatively lower yield of ears of some of the entries, particularly of Illinois 784 and 2119(W), which were below average in dry matter at time of harvest. Both these hybrids have performed well in tests of hybrids for grain production.[1]

Field sampling a dependable method of determining forage yields. When corn is grown in drilled rows, field sampling (selecting individual corn plants at random from rows) is a dependable method

[1] See Illinois Station Bulletin 521, "Illinois Hybrid Corn Tests in 1946," issued in 1947.

Corn used in these tests was grown on gently rolling land in blocks of about 10 acres. Each block was replicated five to six times. This picture of one such block was taken July 2.

Corn usually reached the silage stage early in September and yielded 12 to 15 tons of forage to the acre. This picture was taken September 8. The block is the same as the one shown in the July 2 picture.

of determining yields of forage. This method was compared statistically with yields calculated from the sampling of the completely harvested forage. A comparison of the methods for determining yields of 234 plots gave a correlation figure of .865, a figure considered highly significant for the number of comparisons made.[1]

Field sampling has a number of advantages over the usual method of weighing harvested corn forage from an entire plot or a measured portion of a plot. The method is simple, convenient, and quick. It requires only a little equipment; permits a considerable number of plots to be sampled in one day; and the results are ready in a short time.

Another advantage is that other determinations can be made that are not usually made during harvest. Resistance to lodging can be estimated, and the plants taken for the sample can be measured for height of ear and stalk and proportion of the crop formed by ears, stalks, and blades. Then, too, any one of a number of characteristics of the crop, including percentage of dry matter, yield of forage, and yield of grain, can be followed at regular intervals thruout the season.

Significance of yield differences. Too much confidence must not be placed in the particular ranking of a hybrid in the following tables, for chance has played a part in determining its position. Unaccountable variability in the soil and conditions on the field will cause differences in yield that are not inherent in the hybrids themselves.

The part played by chance in these tests has been calculated for total yield by the mathematical procedure known as "analysis of variance." Above the data for each year in Table 2 is stated the approximate difference which there must be between any two entries in order for them to show a true inherent difference. Unless two hybrids differ by at least this amount, there is no assurance that one hybrid is inherently higher yielding than the other.

Resistance of Plants to Lodging

Erect plants best for clean harvest. Because resistance to lodging is a highly desirable characteristic, it was one of the bases used for evaluating entries. Badly lodged plants may result in much loss of the crop. Lodged plants may not develop as fully as erect plants and so cut yields. Moreover, the harvesting machine may fail to gather the down plants.

[1] When 234 pairs of samples are studied, the minimum correlations required for significance are .130 at the 5-percent level and .170 at the 1-percent level.—G. W. Snedecor, *Statistical Methods,* 1938.

In most seasons little lodging occurred in any of the entries, tho in nearly every crop a little corn borer damage caused some broken stalks. In 1944 a severe windstorm caused considerable lodging in one part of the field. Illinois 863 and 972 proved somewhat less resistant to lodging than the other entries in the 1943 and 1944 tests (Table 2). The strength of all other hybrids tested in these years was satisfactory, as was that of all entries in the other seasons.

Proportion of Ears in Forage

The grain of corn forage has a higher feeding value per pound than the stalks or leaves. A high proportion of ears in the forage when it is harvested for silage is therefore a desirable characteristic of any hybrid, and was given careful consideration in the evaluation of the various entries.

All the hybrids entered in these tests were good producers of grain. There was no conclusive evidence that one was superior to another in the proportion of grain in the forage. Tho differences in this characteristic were rather wide, they were caused chiefly by differences in the stage of development reached by the hybrids when they were harvested. The weight of the ears increases rapidly during the later stages of the development of the crop. Hence when early-maturing and late-maturing hybrids were harvested on the same dates, the ears made up a higher proportion of the weight of the dry matter in the early-maturing hybrids than in the late-maturing hybrids. A high proportion of ears in corn forage at the silage stage is obtained by growing hybrids that are well advanced in development when they are harvested.

In 1943 the average percentage of dry matter in the crop, and the average percentage which the ears contributed to the dry matter, was higher than in the other seasons. There was little difference between entries in these respects (Table 3). In the other seasons the dry-matter content of the crop was lower. Moreover, the proportion of the crop formed by ears was considerably lower than in 1943 and the entries differed much more widely.

Ability to Mature Grain

Silage of good quality depends partly on forage that is mature enough to have a suitable dry-matter content. Hybrids that are incapable of maturing the grain, or that mature it very late, are likely to produce a sour, soggy silage. Such silage is unpalatable and lower in

feeding value than silage made from corn at the right stage of development.

All the hybrids tested in these trials reached a stage at which the dry-matter content of the crop was high enough for silage. Block plantings which remained after the silos had been filled were harvested for grain; the ability of each of the entries to mature the grain proved satisfactory.

Because late-maturing hybrids yield high in tonnage, farmers sometimes consider them best for silage. Such reasoning is unsound, as earlier trials at this Station showed.[1] The late-maturing hybrids give lower yields of dry matter and make poorer silage than hybrids that are fully matured when harvested. Another disadvantage lies in the inability of late corn to mature grain satisfactorily for grain harvest, so that any of the crop remaining after the silo is filled must either be harvested and fed as fodder or used as soft corn.

A study of Table 3 will show how the entries used in the later trials compare in earliness of development and percentage of ears. Two hybrids, Illinois 448 and 784, were used in the tests for seven consecutive years.[1] No. 448 was below average in dry-matter content for five years and below average in proportion of ears in the forage for six years. Illinois 784 was below average in dry-matter content for four years and had less than the average proportion of ears for six years. Both these hybrids are therefore classed as slightly late-maturing for central Illinois. U. S. 13, also entered in the trials for seven years, was for six years a little above average in both dry-matter content and proportion of ears. It may therefore be classed as somewhat early-maturing for central Illinois.

Four other hybrids — Illinois 21, 200, 201, and 206 — were included in the experiment for five years or more.[2] All these were about average in dry-matter content. Illinois 21 was about average in percentage of ears; Illinois 200, 201, and 206 were above average.

Hybrids Were Similar in Protein Content

At the silage stage no one hybrid proved superior to another in protein content of forage. The samples selected for analysis were those obtained from the block having forage nearest to 30-percent dry-matter content at the time of harvest. A dry-matter level of 30 percent is considered ideal for corn silage (Illinois Bulletins 391 and 494).

[1] See Illinois Station Bulletin 391, "Types and Varieties of Corn for Silage," issued in 1933; also Bulletin 494, previously cited.

[2] The 1940 and 1941 data were published in Bulletin 494.

Table 4. — Number of Days Between Planting Corn and Harvesting It for Silage, and the Dry-Matter and Protein Contents of the Forage

(Protein content given as percentage of dry matter)

Entry	1942			1943			1944			1945			1946			Average, all seasons		
	Days	Dry matter	Protein	Days	Dry matter	Protein	Days	Dry matter	Protein	Days	Dry matter	Protein	Days	Dry matter	Protein	Days	Dry matter	Protein
		perct.	*perct.*		*perct.*	*perct.*		*perct.*	*perct.*		*perct.*	*perct.*		*perct.*	*perct.*		*perct.*	*perct.*
U. S. 13	118	31.3	7.06	112	29.0	7.75	108	30.6	8.44	111	27.6	8.00	112	28.4	6.62	112	29.4	7.57
Illinois 21	118	33.2	7.38	110	27.4	8.69	...	....	....	...	....	....	113	28.1	7.25	114	29.6	7.77
Illinois 126	119	35.5	....	...	....	....	...	....	....	111	27.8	8.25	112	28.8	8.73	114	30.7	8.49
Illinois 200	118	31.1	6.50	112	27.1	7.50	...	....	....	118	29.4	7.44	...	....	....	116	29.2	7.15
Illinois 201	118	34.7	6.25	111	31.6	8.13	108	30.6	8.37	...	....	....	...	....	....	112	32.3	7.58
Illinois 206	119	30.2	....	112	31.8	7.75	108	30.3	8.35	111	29.4	8.13	...	....	....	113	40.6	8.08
Illinois 246[a]	...	....	....	112	33.1	8.75	...	....	....	...	....	....	113	28.8	7.72	113	31.0	8.24
Illinois 247[b]	119	32.3	7.50	111	30.7	7.88	...	....	....	...	....	....	113	31.1	6.77	114	31.4	7.38
Illinois 273	...	....	....	...	....	....	105	26.6	8.46	...	....	....	...	....	....	105	26.6	8.46
Illinois 448	119	29.4	6.56	110	27.8	8.06	108	26.4	8.36	112	24.5	7.88	112	25.2	6.99	112	26.7	7.57
Illinois 713	...	....	....	111	29.9	8.06	105	26.6	8.43	...	....	....	...	....	....	108	28.3	8.25
Illinois 784	119	30.9	6.50	110	30.1	7.63	108	29.7	7.51	112	24.6	8.44	112	28.8	6.97	112	28.8	7.41
Illinois 801	121	27.1	7.13	...	....	....	...	....	....	...	....	....	...	....	....	121	27.1	7.13
Illinois 804	122	26.5	....	...	....	....	112	30.2	8.23	112	25.2	8.00	...	....	....	115	27.3	8.12
Illinois 838	123	31.2	7.63	111	28.6	7.94	...	....	....	...	....	....	...	....	....	117	29.9	7.79
Illinois 855	...	....	....	...	....	....	111	29.4	8.25	...	....	....	...	....	....	111	29.4	8.25
Illinois 863	...	....	....	111	33.0	7.19	111	32.2	7.85	...	....	....	...	....	....	111	32.6	7.52
Illinois 877	...	....	....	...	....	....	...	....	....	111	26.6	9.06	112	28.0	7.15	112	27.3	8.11
Illinois 972[c]	...	....	....	...	....	....	106	29.3	7.79	112	25.9	8.38	112	31.6	8.02	110	28.9	8.06
Illinois 2059(W)	...	....	....	...	....	....	...	....	....	111	26.7	8.25	111	26.1	8.09	111	26.4	8.17
Illinois 2077(W)	...	....	....	...	....	....	107	26.8	8.72	117	27.3	7.75	113	27.4	8.96	112	27.2	8.48
Illinois 2119(W)	...	....	....	...	....	....	...	....	....	112	26.5	8.31	113	25.1	7.70	113	25.8	8.01
All entries, average	119	31.1	6.95	111	30.0	7.94	108	29.1	8.23	113	26.8	8.16	112	28.1	7.58	113	29.0	7.82

[a] Includes Illinois 246A-1 in 1946. [b] Includes Illinois 247-1 in 1946. [c] Includes Illinois 972-2 in 1945 and 972A-1 in 1946.

Small differences in protein occurred in individual entries, but there appeared to be no consistent differences between the entries (Table 4).

Protein values in 1942 were lower than in the following seasons. These lower values may have been due partly to seasonal differences, tho it is probable that the lower fertility level of the 1942 field was an important factor. Two other factors that affect the protein content of corn forage are the stage of development reached by the ears when the forage is harvested and the proportion of ears in the forage.

DRY MATTER IN FORAGE BEST INDEX TO HARVEST STAGE

In general, the higher the dry-matter content of the corn crop the more advanced the crop and the higher the test weight of the grain per bushel and, consequently, the higher the weight of 500 kernels. For example, the 1943 crop had the highest dry-matter content (average of 30.3 percent, Table 3); the average test weight of the grain was high, and the weight of 500 kernels was high (Table 2). In 1945 the crop was harvested when the average dry-matter content was only 25.5 per cent; and the test weight per bushel and the weight of 500 kernels (Table 2) were much lower than in 1943.

It is not always true, however, that the dry-matter content of the crop indicates the relative development of the grain. In three seasons, 1942, 1945, and 1946, the average dry-matter content of the crop at harvest was very similar, being 26.0, 25.5, and 26.9 percent respectively (Table 3); but the test weight of the grain and the weight of an equal number of kernels was much smaller in 1945 than in the other two years (Table 2). This observation gives additional support to the recommendation made in previous publications of this Station (Bulletins 391 and 494) that a determination of the dry-matter content of the forage is a better index of the proper harvest stage than is an estimate of the condition of the ears.

Leaves are best guide to harvest stage. A study of the dry-matter content of the ear, stalk, and leaf portions of the corn crop showed that when corn is grown under soil and climatic conditions such as those at Urbana, the dry-matter content of the leaves is a good guide to the best time to harvest the crop. These findings confirm those previously reported in Bulletin 494. The most reliable guide, of course, is a determination of the dry-matter content of the entire crop. Such a determination indicates with a high degree of certainty

whether a crop harvested at a given stage will make silage that will keep well.

In most seasons the leaves and crop had nearly the same average dry-matter content (Table 3). The stalks had a considerably lower percentage of dry matter than the leaves, while the ears had a considerably higher percentage. These relationships held good for most of the 180 individual determinations and for the averages of the 60 entries. They may not hold good, however, when the dry matter of the crop rises to 35 percent or more, for under such conditions the leaves dry rapidly and may not form a good index to the condition of the crop as a whole. This fact was pointed out in Bulletin 494.

RATINGS OF TWENTY-SIX HYBRIDS

The final evaluation of a hybrid requires several years' tests and is dependent on many characteristics. Also, because of possible year-

Table 5. — Ratings of Corn Hybrids Tested for Their Ability to Produce Forage for Silage

Rank in general performance[a]	Entry	Ratings for—			Number of years grown
		Yield of forage	Erect plants	Proportion of grain in forage	
1	Illinois 206	4	10	7	6
2	Illinois 972A-1	5	..	8	1
3	Illinois 863	1	14	14	4
4	U. S. 13	15	7	3	7
5	Illinois 200	7	7	11	5
5	Illinois 713	10	4	10	4
7	Illinois 877	3	..	15	2
7	Illinois 247-1	6	..	12	1
7	Illinois 246	19	5	1	1
10	Illinois 273	25	1	2	1
11	Illinois 972-2	19	..	5	1
12	Illinois 201	22	9	4	5
12	Illinois 247	24	3	5	2
14	Illinois 801	2	11	26	1
15	Illinois 784	8	15	21	7
15	Illinois 838	10	13	20	4
17	Illinois 126	16	16	13	3
18	Illinois 21	21	2	16	5
19	Illinois 804	13	18	17	3
20	Illinois 448	12	12	22	7
21	Illinois 972	23	19	8	1
22	Illinois 2119(W)	9	..	25	2
23	Illinois 2077(W)	17	16	18	3
24	Illinois 246A-1	14	..	22	1
25	Illinois 2059(W)	18	..	19	2
26	Illinois 855	26	5	24	1

[a] The ranking of each hybrid is calculated by allowing 40 percent for its yield-of-forage rating, 20 percent for its erect-plant rating, and 40 percent for proportion-of-grain rating. In the absence of a rating for erect plants, a value of 50 percent was assigned to each of the other ratings.

to-year differences in the condition of the seedbed, planting rate, and cultivation, as well as in weather, insect pests, and diseases, a valid comparison of different hybrids is possible only when they are grown in the same seasons. And such a comparison must be based on a statistical analysis of the significance of the yields.

Final judgment must take into account all the various qualities and values discussed in the preceding sections. Main considerations, however, are: (1) yield of forage; (2) proportion of erect plants; (3) proportion of ears; (4) ability to mature grain; and (5) protein content of the forage.

The summarized ratings given in Table 5 are based on only three of the above measurements: forage yields, percentage of erect plants, and proportion of ears in the forage. Ability to mature the grain is not included in the table as a rating because it is closely associated with the proportion of ears in the forage, and proportion of ears is a more exact measurement. A rating for protein content is also omitted because the differences in the protein contents of the hybrids tested were so small that a rating based on such differences would be unfair.

The entries are arranged in Table 5 in the order of their rating for general performance, the one having the best all-round performance, Illinois 206, being given first place. In several instances two or more hybrids have equal numerical ratings, as for example, Illinois 200 and Illinois 713. But since Illinois 200 was entered in the tests for five years, it is given precedence over Illinois 713, which was grown only four years. (Note that ratings of ten of the entries are based on the tests reported in Bulletin 494 as well as on the trials reported in this bulletin.)

SUMMARY AND CONCLUSIONS

For five seasons, 1942 thru 1946, corn hybrids were tested for their ability to produce forage for silage. The hybrids were grown at Urbana, only those that had shown good performance in grain tests being chosen for the forage tests.

The yields were determined by two methods. The first consisted of field sampling: the plants in measured rows were counted and a given proportion of them harvested. The weight and dry-matter content of the ear, stalk, and leaf portions of these samples were determined. The second method consisted of weighing and sampling the completely harvested crop from measured areas of each entry. The yields were calculated from the weight of the forage and the dry-matter content of the samples. The average results of the two methods were

in close agreement, a statistical study of the yields determined by the two methods showing that the field sampling of standing drilled corn is as dependable a means of arriving at yields as the weighing and sampling of a completely harvested crop.

All of the hybrids entered in the tests proved to be high producers of forage and were satisfactory for silage purposes. Some matured slightly later than others. The ability to mature grain is a desirable characteristic if the crop that is left after silos have been filled is to be harvested for grain. Good lodging resistance (ability of the plants to stand erect) is also an essential characteristic of good silage corn. Resistance to lodging was satisfactory in all entries except Illinois 863 and 972.

In proportion of ears, the various entries differed somewhat from season to season. A high proportion of ears is an advantage because the grain has greater feeding value than the leaves and stalks. The stage of development at harvest, as shown by the percentage of dry matter in the forage, was found to be one of the most important determinants of the ear content of the forage. The relationship between stage of development at harvest and ear content of forage was fairly close. Early-maturing hybrids contained a higher percentage of ears at harvest than later-maturing hybrids.

This study furnishes additional evidence that the leaf portion of corn forage at the silage stage has a dry-matter content nearly the same as that of the entire crop. Hence a dry-matter test of the leaves may be used as an index of the suitability of the crop for silage harvest.

The protein content of the forage varied from season to season, but none of the hybrids in the trials appeared superior to others in this component.

Small differences in yield are usually not significant, and the reader is urged to keep this in mind when studying the tables showing yields.

6050—4-49—40690